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THE
LARYNGOSCOPE.

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THE INTELLIGIBILITY OF CONNECTED DISCOURSE AS A TEST FOR THE "THRESHOLD FOR SPEECH."*

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Current articulation tests to determine the threshold of intelligibility or "threshold for speech" employ lists of either nonsense syllables, numbers, words or sentences. The thresholds of such tests are usually defined as the lowest intensity level at which the listener hears correctly 50 per cent of the test material. The lists are very often long and, consequently, time consuming and fatiguing. A quicker, although less objective, test uses a recorded sample of actual everyday connected discourse and the listener determines for himself where his threshold of intelligibility is by varying the intensity of the speech until he can just hear and understand what is being said. Of course, the sample of speech used for such a test must be "monitored," that is, its intensity level must be constant, except as it is varied by the listener.

The present paper is a study of the reliability with which normally-hearing and hard-of-hearing individuals can select a threshold of intelligibility for connected discourse (TICD) by the method outlined above. We felt that by the self-selection technique a quick measure of the threshold of intelligi-

*From the Research Laboratory of the Central Institute for the Deaf. This work was completed under Contract N6onr-272 between the Office of Naval Research and Central Institute for the Deaf. The experimental material formed the basis of a thesis submitted by one of the authors (G.A.F.) in partial fulfillment of the requirements for the degree of Master of Science in Education, Washington University.

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bility might be obtained with connected discourse. Such a test would simulate everyday listening. It might be more interesting to the listener because he, himself, would make the test. The technique might also eliminate the emotional disturbance that often occurs when an anxious listener begins missing some of the items in the ordinary form of test. The listener in our test, varying the intensity himself, does not become concerned about not hearing, because he can restore intelligibility immediately by adjusting his attenuator. It was the observation of this emotional factor in routine clinical tests of the threshold for speech that brought to our minds the question of how well an individual might select his own threshold of intelligibility.

APPARATUS AND TEST MATERIAL.

The electroacoustic apparatus employed has been described in detail by Walsh and Silverman.[5] Briefly it consists of a turntable, an electrical pickup, an amplifier, a monitoring meter, an attenuator under control of the operator, a second attenuator (Daven PT 320-F, with 2 db. steps) under control of the listener, and a receiver (Permoflux PDR-10) with rubber cushion held against the listener's ear by a suitable headband. The listener sits in a quiet, sound-treated room; the observer and the turntable, amplifier, etc., are located in an adjacent control room.

The sample of connected discourse used throughout the present experiments was a newscast by Fulton Lewis, Jr., transcribed from the radio network lines by the Technisonic Recording Laboratories at Central Institute for the Deaf. This sample was chosen because of its evenness of level, the natural conversational style of speaking, and the simplicity of language and subject matter. The same sample was used in a previous study in this laboratory.[3]

A calibrating tone of 1,000 c.p.s. was recorded on the disc. Throughout the four minutes and 45 seconds' playing time, the speech level, as measured by the V.U. meter, is within $\pm$ 2 db. (usually within 1.5 db.) of the level of the calibrating

tone. In our experiment each pressing (vinylite) was discarded after about 50 playings.*

As a well standardized current test of the "threshold for speech" with which to compare the test by connected discourse, we selected the recorded form of Auditory Test No. 9, developed by the Psycho-Acoustic Laboratory. Test No. 9 consists of lists of 42 familiar spondaic words spoken by a male voice at five-second intervals. The words in each list are divided into seven groups of six words each, and each group is recorded at progressively lower levels of intensity, 4 db. apart. Thus the range on the disc is 24 db. Threshold is the level at which 50 per cent of the words in a group are repeated correctly by the listener, and was calculated by the tabular method described by Hudgins, *et al.*[2]

PRELIMINARY TESTS.

A preliminary study (described in detail elsewhere)[1] was made on six normal and 41 hard-of-hearing subjects to establish appropriate methods for the main experiment. Seven of the subjects (including the six normals), while listening to the sample of connected discourse, made three settings of the attenuator to "the level at which he could just understand the speech." The test was repeated for each of the six normal and one hard-of-hearing subjects on six different days.

The results showed no evidence of learning by the listeners. Neither practice nor familiarity with the particular sample of speech seemed to influence the results. The mean of the first three settings (constituting the first test) was very nearly the same, for each listener, as his mean for the entire series of six tests; and there was no significant upward or downward trend for the group. In planning the main experiment it was, therefore, considered unnecessary to include extended tests on each listener.

In the preliminary experiment, the 41 listeners made very few obviously erratic settings; however, to minimize the

*Vinylite pressings of this recording are available at cost at Central Institute for the Deaf, 818 South Kingshighway Boulevard, St. Louis 10, Mo.

effect of occasional erratic settings, and because of the greater convenience in clinical practice of dealing only with whole numbers in expressing the results of a test, we selected the *median* (instead of the mean) of the three settings as the measure of the listener's threshold of intelligibility. (Actually the group median and the group mean of the results were almost identical.) We learned, however, that the instructions to the subject are critical for the reliabilty of the test. Adoption of the set of instructions (given below) midway through the preliminary experiment with 40 hard-of-hearing subjects increased the reliability of the test significantly.

SUBJECTS.

Both normal and hard-of-hearing subjects were chosen for the main experiment.

The ages of 25 individuals with normal hearing ranged from 17 years to 39 years. Their pure tone thresholds were determined by means of an Audio Development Company audiometer. A subject's threshold was regarded as normal if it showed no hearing loss greater than 10 db. at the frequencies 256, 512, 1,024, 2,048 and 4,096 c.p.s. Acuity for speech was assessed by Auditory Test No. 9. Any speech threshold was considered normal if it was within two times the standard deviation of the norm.[4] [The norm, for this group of normal listeners, proved to be 22.46 $\pm$ 2.6 db. (re 0.0002 dynes/cm.^{2})].

The hard-of-hearing subjects included 15 men and women who were candidates for the fenestration operation and had come to the Hearing Clinic at Central Institute for the Deaf for a series of diagnostic tests, and also 32 hard-of-hearing subjects who had undergone the fenestration operation and had returned to the clinic for evaluation of the results. An otologist determined clinically the type of impairment for each subject as either pure conductive or mixed deafness. Their ages ranged from 17 years to 41 years.

PROCEDURE.

After the audiometric tests the subject was seated in a comfortable chair in the sound-treated chamber.[3,5] The calibrated earphone was placed over his right ear and the No. 9 test was administered to determine his threshold for speech. An attenuator box was then placed on his lap, and he was handed a card bearing the following typewritten instructions:

> You are going to hear a man talking. His voice will be loud. By turning the dial away from zero, you can make the speech softer and softer. Please turn it to the lowest point where you can understand everything the speaker is saying. You may reach a point where some of the words seem to drop out. By turning the dial back a point or two, those words will come in more distinctly. That is the point we are seeking. Call the dial reading off to me. Turn the dial back to zero and begin again. Repeat the setting twice—three times in all. The tests will not start at the same loudness; therefore, do not expect to arrive at the same number on the dial each time. Be quick but be accurate.

The dial reading for each setting was recorded. The time required for each setting was measured in seconds and recorded.

To make certain that the subject would not use his initial setting as a reference for the next two settings, the observer varied the setting of his own attenuator (in series with the subject's attenuator), but he attempted to keep the starting loudness within a range of from 10 db. to 30 db. above the estimated threshold of intelligibility of the subject. This allowed the subject plenty of room to play up and down the intensity scale without confining him to either the first or last few detents on his attenuator. (The subject's attenuator had a range of 38 db. in 2 db. steps.) The starting level of the speech was always kept at an even number of decibels so as to conform with the even numbers on the subject's attenuator.

The procedure was repeated for the subject's left ear. By this time he had become sophisticated enough to disregard the written instructions. If, however, there was any question about the interpretation of the instructions, he was asked to re-read them. It was rarely necessary to make verbal elaborations.

The No. 9 lists were varied from test to test, but the same recording of connected discourse was used repetitiously, since the preliminary experiment had shown that familiarity with the material had no apparent effect on the results. Below is an outline of the order of the tests for the subjects with normal hearing:

1. Auditory Test No. 9, right ear.
2. TICD Test, three settings, right ear.
3. Auditory Test No. 9, left ear.
4. TICD Test, three settings, left ear.
5. Retest No. 9, right ear.
6. Retest TICD, three settings, right ear.
7. Retest No. 9, left ear.
8. Retest TICD, three settings, left ear.

For the hard-of-hearing subjects the TICD test was incorporated into the regular testing routine of the fenestration patients in such a way as to disrupt the routine as little as possible and at the same time to simulate closely the procedure outlined above. The order of the tests was as follows:

1. Auditory Test No. 9, right ear.
2. TICD Test, three settings, right ear.
3. Auditory Test No. 9, left ear.
4. TICD Test, three settings, left ear.
5. Retest TICD, three settings, right ear.
6. Retest TICD, three settings, left ear.

TIME REQUIRED.

The time required for each individual setting ranged from 10 seconds to two minutes. Most subjects made the settings in from 20 to 40 seconds each. Usually the first setting required more time, but the subjects learned quickly and soon were able, as a rule, to obtain a threshold setting in about 20 seconds. The few who required a minute or more to make each setting were actually likely to vary more in their endpoints from test to test than those who made the settings

more quickly. The hard-of-hearing subjects required neither more nor less time than the subjects with normal hearing. They showed the same individual differences in speed, but the differences were not correlated with the degree of hearing loss.

The total time required, therefore, for the three settings that constitute a routine measurement of this threshold of intelligibility for connected discourse, is *about two minutes as a rule* and rarely more than three minutes. The time is significantly less than the four or five minutes required for ordinary articulation tests, such as the Western Electric 4-C, Tests No. 9, No. 12,[2] or a PB word list.[5]

NORMAL THRESHOLD OF INTELLIGIBILITY FOR CONNECTED DISCOURSE.

The group mean for our normal listeners for TICD was 23.23 ± 3.77 db. (re 0.0002 dynes/cm.^{2}). This threshold obviously lies very close to our threshold for Test No. 9 (22.46 ± 2.63 db.). The small difference between these two thresholds is interesting because at the threshold of intelligibility the subjects believe that they are understanding practically *all* of the words in our sample of connected discourse, yet the level is only 0.77 db. above the level at which they hear correctly only *50 per cent* of the relatively easy (but isolated) words of the No. 9 test.

For further comparison we may note that the threshold for the No. 12 (sentence intelligibility) test is known to be about 4 db. above the threshold for No. 9.[2] For the hard-of-hearing subjects the TICD depends upon the hearing losses, and the mean for the group, therefore, has no particular significance.

RELIABILITY OF THE TICD MEASUREMENTS.

All of the settings made by our normal subjects are given in Table 1.

TABLE 1. INDIVIDUAL SETTINGS FOR THRESHOLD OF INTELLIGIBILITY FOR CONNECTED DISCOURSE. N = 25. The Columns Are Arranged in the Order of Testing. (Decibels Re 0.0002 Dynes/CM.^{2}).

Subject	First Series (Right Ear)			Second Series (Left Ear)			Third Series (Retest, RE)			Fourth Series (Retest, LE)		
M. B.	28	28	26	24	24	22	24	28	28	24	28	22
L. W.	26	26	26	30	28	30	26	24	26	26	26	26
E. M.	28	32	32	26	26	24	30	30	32	28	24	24
M. M.	22	24	28	24	24	26	24	22	22	24	26	28
H. W.	24	22	22	22	22	24	20	22	22	24	22	24
M. T.	24	18	18	24	24	24	26	28	26	22	26	26
K. M.	26	22	24	22	22	20	20	22	20	22	22	24
P. M.	24	22	26	22	24	24	20	22	22	22	24	22
J. D.	20	24	24	20	18	18	24	24	20	22	18	20
J. S.	28	28	32	20	20	24	30	28	28	22	24	22
R. M.	32	30	28	24	24	24	26	24	24	24	22	24
F. M.	24	20	22	32	28	28	24	22	22	26	26	28
K. G.	22	24	26	24	26	28	26	32	28	26	26	28
W. H.	30	28	30	28	26	28	26	26	30	26	28	28
W. M.	26	26	26	20	20	24	24	22	26	20	20	18
D. L.	14	16	14	18	16	14	16	16	16	18	16	20
B. D.	28	22	24	22	22	18	22	20	24	20	22	24
C. L.	26	20	18	22	24	24	20	18	20	26	26	26
D. S.	20	20	20	18	20	18	18	22	12	20	22	20
H. B.	18	18	20	16	18	18	22	16	14	16	16	14
I. T.	16	18	18	20	18	24	18	22	22	24	20	22
M. P.	22	24	22	22	22	22	28	22	24	24	24	26
M. A.	22	22	24	22	22	20	22	22	22	22	26	20
J. C.	26	22	24	26	26	26	24	22	22	22	22	22
D. M.	26	26	28	24	26	26	20	22	26	22	22	20

It is from these data that the group mean was calculated. From these same data and from similar data for the 94 hard-of-hearing ears the data of Table 2 were calculated.

TABLE 2.

Number of Ears	Average range for the 6 settings (test-retest) in 1 ear	Average range for a series of 3 settings	% of test-retests yielding 6 settings within a range of 4 db.	% of tests (3 settings) with a range of 2 db. or less
50 Normal	5.0 db.	2.82 db.	58%	60%
94 H.O.H.	4.55 db.	2.59 db.	61%	65%

Further calculations from Table 1 show that the average range for the first series of three settings (for normal subjects) is 0.4 db. greater than the average range for the three settings of the final (fourth) series. This difference is too small to be clearly significant of a trend, but if real, it indicates a slight learning factor.

It is not surprising that the range for six settings is usually greater than the range for three settings. Not only are there more chances for error, but the average intensity level of the speech sample varies from moment to moment over a range of about 3 db. The listener may actually be making an accurate judgment according to the intensity level of the recorded speech at that particular moment. Recall, also, that the subject cannot adjust the intensity level in steps of less than 2 db. In fact, it is rather surprising that 58 per cent of the normal subjects made the six settings for one ear within a total range of 4 db.

Only one individual had a range of as much as 10 db. for a single series of three settings. This was D. S., who gave one erratic setting of 12 db. (re 0.0002 dynes/cm.^{2}). This is close to the intensity level at which the normal listener can just detect the presence of speech sounds. It is probable that he made a 10 db. error in reading the dial, as his 11 other settings ranged from 18 db. to 22 db.

With respect to the maximum range of settings, the hard-of-hearing subjects did a little better than the normal subjects. Three of the normals had a range of 10 db. for the six settings for one ear. Only one hard-of-hearing subject had such a wide range, and no hard-of-hearing listener had a range of more than 8 db. for a series of three settings.

STANDARD ERROR OF MEASUREMENT.

We have discussed the maximum range of settings because it shows the greatest deviations that occurred in exceptional cases. A better measure of the reliability of the test, however, is the standard error of measurement. For the 25 normal subjects the standard error of measurement was 2.4 db.

for the TICD. For the hard-of-hearing subjects it was only 1.95 db.

These standard errors of measurement compare very favorably with the corresponding standard errors of measurement for Auditory Test No. 9. For our normal subjects this was 2.86 db. Hudgins and his associates[2] reported a standard error of measurement for Test No. 9 of 2 db. for 30 normal subjects under very favorable conditions. For another normal group under less favorable conditions their standard error of measurement, like ours, was 2.4 db.

A standard error of measurement of 2.4 db. means that two-thirds of the individual measurements lie within 2.4 db. of the true score for that individual; *i.e.*, the value that would be obtained from a very large series of measurements. This error of measurement of the threshold of intelligibility of connected discourse is less than 2.5 db. Compare this with the 5 db. range of uncertainty that is considered "inherent" in clinical pure tone audiometry.[6]

TEST-RETEST RELIABILITY.

The average difference between the first value for the TICD of a particular ear and the retest value for the same ear was 1.84 db. The average difference for all right ears, which were systematically tested first, was 2.16 db. and for all left ears it was 1.52 db. The smaller average difference for the left ears may be due to a slight learning factor. Experience seems to improve the reliability of the subject's performance even though it does not significantly affect the absolute value of his average threshold.

For the hard-of-hearing subjects the average difference between the first and the second measurement of the threshold of the TICD was 1.98 db. This is not significantly different from the value for the normal group.

The values for both normal and hard-of-hearing subjects on the TICD test are slightly less than the average test-retest difference for Auditory Test No. 9 for our normal group, 2.08 db. (Our hard-of-hearing subjects were not re-

tested on No. 9.) The slightly greater reliability with experience is also reflected here, as the test-retest difference on No. 9 for the right (first) ears was 2.32 db. and for the left ears, 1.84 db.

RELATIONSHIP OF TICD TO AUDITORY TEST NO. 9.

The relationship between the threshold of intelligibility for connected discourse and the threshold for speech measured by Auditory Test No. 9 (spondaic words) has been discussed in terms of group averages, standard errors of measurement, and test-retest reliability. It is obvious that the two tests are very closely related and that the TICD compares very favorably with No. 9 with respect to both dispersion and reliability. The absolute thresholds (means for the normal group) lie within 1 db. of one another. It should be possible, therefore, to predict with considerable accuracy from a measurement of the TICD what an individual's score on Test No. 9 would be. Since No. 9 is now well accepted as a test for the "Threshold for Speech," such a comparison is of interest.

The score for each normal ear on TICD was compared with the No. 9 score for the same ear. The differences, as might be expected, ranged, apparently at random, about a central tendency. (The TICD's averaged, of course, about 1 db. above No. 9.) The *greatest* difference between the TICD (either first test or retest) and the No. 9 threshold for the same ear was 8 db. Only four of the 50 normal ears showed a difference of more than 6 db. between TICD (test or retest) and a value 1 db. above the No. 9 threshold for that ear. For five of the ears both TICD thresholds (test and retest) and the No. 9 thresholds were all identical. As a matter of fact, the TICD agrees almost as well in all respects with the No. 9 threshold as it does with its own retest value.

For the hard of hearing the agreement between No. 9 and the TICD scores is nearly, but not quite, so close. In 10 cases among the 94 hard-of-hearing ears the difference between TICD, either test or retest, or both, and the corresponding No. 9 threshold was more than 8 db. The percentage of tests was calculated for which the TICD value deviated from a

value 1 db. above the No. 9 threshold (for the same ear) by more than 6 db. Thirteen per cent of the hard-of-hearing ears showed a difference of more than 6 db. on *both* test and retest, and an additional 23 per cent deviated by more than 6 db. on *either* test or retest. It seemed possible that the larger deviations might be systematically related to the nature of the hearing impairment of the particular ear. When the individual cases were examined, however, no relation was found to either the extent or the direction of the deviation of the TICD threshold from the No. 9 threshold. One of the two cases in which TICD lay farthest above the No. 9 score was diagnosed by an otologist as having conductive deafness. The other ear which deviated equally far in the same direction was diagnosed as having a mixed deafness with predominant nerve involvement. On the other hand, an ear in which the TICD threshold lay farthest below the No. 9 score had a mixed deafness with predominant nerve involvement and the second extreme in the same direction had a pure conductive type of deafness. (There were no cases of pure nerve deafness in this study as all of our cases had had, or were candidates for, the fenestration operation.)

VALIDITY.

When we measure the "Threshold for Speech" we want to know the extent to which an individual is handicapped in hearing ordinary conversation. It is obvious that such a sample of connected discourse as we have chosen, taken directly from a radio network, is a more representative sample of everyday speech than the artificially selected two-syllable words of Test No. 9. The TICD test has very high face validity. To the extent that it is superior in this respect to No. 9, the close agreement between the No. 9 and the TICD may be regarded as a further validation of Test No. 9 as a measure of the threshold for speech.

The obvious weakness of the TICD test lies in the subjective character of the end-point. We were both surprised and pleased to find how consistently subjects seem to agree with one another on what constituted the "threshold of intelligibil-

ity." But the occasional deviations of 8 db. or more between the TICD and the threshold by Test No. 9 probably represent situations in which the listener has adopted some other end-point. Actually, there are at least four possible thresholds lying relatively close to one another on the intensity scale, and any one of them might be chosen by a listener with fair reliability. These are *1.* the threshold of *detectability*, the intensity level at which the listener is able to detect the presence of speech sounds about half the time without being able to identify any of the sounds themselves; *2.* the threshold of *perceptibility*, the level at which the listener is able to understand with considerable effort the gist of the speech; *3.* the threshold of *intelligibility*, the level at which he can understand the speech with little effort; and *4.* the less clearly defined threshold of *comfort*, the level at which he can understand the speech most easily. This last is sometimes called the level of *preference*. Unless the threshold of intelligibility is clearly described to the listener, he may select one of the related thresholds.

Sometimes the subject seems to be consistent in his wrong choice of threshold throughout the whole series of tests, but sometimes he seems to shift his criterion spontaneously. For example, among the normal subjects, D. L. and C. L. gave more satisfactory scores when the left ear was tested. H. B. persistently chose a low level throughout the entire session. Actually, D. L. could not repeat the thoughts expressed in the speech sample when he was asked to listen for a time at the intensity level he had chosen as his threshold of intelligibility. (This was done as a check only after the experimental tests had been completed.) Actually, there seems to be a larger percentage of hard-of-hearing subjects who show large differences between the TICD and the threshold by No. 9. The No. 9 test is objective in the sense that the listener must repeat the word that he has heard and is, therefore, free from the weakness of the TICD test that we have just pointed out. But, particularly for rapid screening, it may be that the shorter time required for the TICD test will more than offset the slight uncertainty introduced by its subjective end-point.

FATIGUE.

Another expectation was that the TICD test might be less fatiguing. No special attempt was made to measure fatigue (mental fatigue, not auditory fatigue), but the subjects were asked how they liked the test in comparison with the word tests. Many of them liked the idea of the subject testing himself and found it interesting and stimulating. On the whole, the test was accepted with an unusual amount of enthusiasm. No definite conclusions can be drawn concerning the factor of fatigue, and it is probably of little importance. The fact that the test is less time-consuming and more interesting than many articulation tests makes it safe to assume that it is to some degree less fatiguing.

SUMMARY.

1. A recorded test for the threshold of intelligibility for connected discourse (TICD) is described. The listener selects his own threshold by adjusting the volume control.

2. The advantages claimed for this test are:

   A. Speed (about two minutes).

   B. Interest for the listener and lack of fatigue.

   C. High face validity. (It uses a sample of an actual radio broadcast.)

   D. Satisfactory reliability.

   E. Negligible learning effects.

3. The chief disadvantage of the test is the subjective nature of the end-point. An occasional subject gives an erratic threshold.

4. The TICD test was compared experimentally with Auditory Test No. 9 (spondaic words), using 50 normal and 94 hard-of-hearing ears. The thresholds obtained by the two tests were nearly identical. The normal and the hard of hearing were about equally reliable, with a slight advantage in favor of the hard of hearing.

5. Quantitative comparisons are summarized in the following table:

	NO. 9 — TICD.	
Normal Threshold (N = 50)	22.46 ± 2.63 db.	23.23 ± 3.77 db.
Standard Error of Measurement, Normal	2.87 db.	2.4 db.
Standard Error of Measurement, Hard of Hearing (N = 94)	Data not available	1.95 db.
Test-retest Difference, Normal	2.08 db.	1.84 db.
Test-retest Difference, Hard of Hearing	Not done	1.98 db.
	50 NORMALS — 94 HARD OF HEARING.	
Average range of TICD { 6 settings.	5.0 db.	4.55 db.
Average range of TICD { 3 settings.	2.82 db.	2.59 db.
Percentage of ears for which TICD, (test, retest, or both) differed from No. 9 by more than +7 or —5 db.	8%	36%
Percentage of ears for which TICD, both test *and* retest, differed from No. 9 by more than +7 or —5 db.	0%	13%

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A CHRONICLE OF 100 YEARS OF OTOLARYNGOLOGY.*

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To recount a century of otolaryngological achievements is to undertake a task of great magnitude and responsibility. An initial inquiry into the progress of otolaryngology during the past 100 years reveals an extreme breadth of material that deluges any attempt at selection and baffles the preparation of a readable and coherent text. It is amazing to note the accumulation of bibliographic data of professional significance deposited within our otolaryngological storehouse during the past century. Obviously I cannot remove all of them, classify them specifically and work them into something of tangible educational value for practical usage. I can hope to touch only the high spots of 100 years of advance, not in the form of a catalogue but more as a record in abstract of those accomplishments with which I can claim some personal experience.

An awareness of the impact of contemporaneous developments in medicine outside the field of pure otolaryngological discovery is a responsibility that must be faced in treating this subject. The science of otolaryngology has not grown and developed as an entity distinct and separate from the other sciences. To illustrate this point I need mention only the tremendous influence which the discovery of the chemotherapeutic and antibiotic agents exerted upon otolaryngological diseases during the past decade. Sir Alexander Fleming's colossal discovery of the antibacterial effects of penicillin has revolutionized the practice of otolaryngology and altered it to such extremes that it now bears only a faint resemblance to its stature of a decade ago. Here we observe the tremendous effects of contemporary discovery. The acute infections

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of the pharynx, retropharyngeal abscess, peritonsillar abscess and the deep suppurations of the neck have nearly vanished. The acute inflammatory processes within the sinuses run a course of short duration and seldom give rise to complications under the influence of the chemotherapeutic and antibiotic agents. The serious complications of mastoiditis which comprised a significantly important responsibility of otolaryngological practice and held the major interest of the members of our profession 10 years ago are rarely in evidence today. The almost complete annihilation of temporal bone surgery and the marked decrease in the incidence of acute suppurative processes within the structures to which we give attention have prompted the statement many times in otolaryngological circles that otolaryngology has entered upon a period of decadence.

The future of otolaryngology is, however, by no means dark. There are great resources in this field which have not yet been tapped, and these will be made available through scientific research. There are colossal opportunities for research in otolaryngology today, the promotion of which will open many new fields for practice. Consider if you will the unsolved problems of cancer, allergic reactions, nerve regeneration, the neurological manifestations of otolaryngological diseases, deafness and the rehabilitation of the hard of hearing; these and many others furnish innumerable investigative studies in which the joy of creativeness will be experienced by many of our colleagues and from which new methods of practice will be derived.

In the 20-year period from 1840 to 1860 there is little significant literature pertaining to the clinical aspects of the ears, nose and throat. Anatomical studies had been made but they were not correlated with clinical observations in any attempt to rationalize etiological influences and the behavior of disease. Isolated cases of epistaxis, sore throat and injuries to the ears and nose were described, but records were brief and methods of treatment devoid of any vitality that would permit them to live beyond their time.

It must be acknowledged, however, that otorrhea was

attracting the attention of some observers and exciting apprehension because of its potencies for serious complications. It was suspected at first that a discharge from the ear afforded "relief to some other local irritation." We find it stated that "in teething, ophthalmia and other inflammations, nature very commonly establishes this discharge which undoubtedly relieves these diseases." The evil consequences of chronic suppurative otitis media, namely, meningitis and brain abscess, were becoming subjects of grave consideration. As one writer expresses, "the disease may pass through the delicate organs of hearing, attack the membranes and even the substance of the brain producing then and not till then convulsions and death." One author recollects that "when a boy, in company with others, boys and men, a common amusement among them was to blow smoke from their segars they were using through their ears and a considerable percentage of these individuals in a country village could perform this feat."

While Phillip Bozzini, a German physician, announced, in 1795, that he had conceived a means of performing endoscopy, he did not describe his endoscope until 1805. His invention received only scant attention and occasioned little interest until about 40 years later, when, in 1843, an English surgeon, John Avery, described an instrument which visualized the vocal cords "better than it had ever been possible to see them before." Ten years later, in 1853, Desormeau, a French physician in Paris, described an illuminated instrument of such practical value that historians have designated him the "Father of Endoscopy."

While the instruments and techniques for practical endoscopy upon living human subjects developed approximately 100 years ago, the idea of examining the cavities of the bodies was posed some 40 years before this period. It is another instance of one of the sad reproaches to the scientific world; namely, that many of our great discoveries go unnoticed and are lost to humanitarian service for many years after they have been made available to us. Sulfanilamide, prepared in 1908, remained dusty on the organic chemists' shelves for

a quarter of a century before it was recognized as a great savior of suffering and untold human lives. Similarly, penicillin was discovered in 1929, yet it remained obscure and attracted little attention until the pressure of demand was felt by the advent of World War II.

Mirror laryngoscopy was described in 1792, but the mirror as a diagnostic instrument was not employed to any great extent until its advantages were recommended by Czermak in 1858. Nearly 90 years have elapsed since this important but simple diagnostic procedure was recommended, yet it is still neglected all too frequently by physicians in their routine daily practice. We continue to emphasize the great need of an early investigation of the causes of hoarseness; lesions which reveal their true identity in the vast majority of cases in the reflected image of the larynx in a mirror, yet hundreds of patients with operable carcinoma of the larynx come to grief yearly because of sheer neglect. It is another instance "of the obvious thing being the one most frequently overlooked."

In 1860 we begin to read an otolaryngological literature which departs from generalities and records something which is more concrete. Otolaryngologists began to focus their creative energy upon specific anatomical studies, etiology and the diagnostic signs and symptoms of disease. Joseph Gruber, Prussack and Kessel studied the histology of the tympanic membrane, investigated its attachment to the handle of the malleus and the short process, and wrote in general on some anatomical considerations of the middle ear. These studies brought enlightenment to the clinical behavior of disease and inspired reports of acute and chronic suppurative processes in the temporal bone, and functional disturbances of the auditory mechanism. The rôle of the Eustachian tube in admitting infection from the nasopharynx to the tympanum was recognized. Politzer's air douche was recommended after perforation of the tympanic membrane had occurred.

While the otolaryngologists of this age were familiar with the etiology and symptomatology of acute suppurative processes in the temporal bone and aware of their complications,

they were obviously woefully lacking in knowledge of adequate treatment; but they were not without their convictions. In their characteristically professional manner, they write succinctly and without fear of derision concerning the specific virtues of "half-moon blisters, applied behind the ears, and an ear lotion of 4 gr. of the acetate of lead to an ounce of water instilled into the ear, the use of mild astringent gargles, fluid extract of sarsaparilla, a teaspoonful internally twice a day, exercise in moderation, and the avoidance of coffee and most of the unnecessary stimulants."

In the 1870's we note that the conservative treatment of acute otitis media versus paracentesis of the tympanic membrane is a controversial issue. The literature records a great deal of acrimonious dispute on this matter even to the extent of severe ridicule and bitter imputations for those who resort to surgical measures. One writer, in 1876, lays great stress on careful cleansing of the ear with an alkaline solution but vigorously opposes the paracentesis. He calls it a "fashionable operation" and concludes by analogy that "if no oculist would perform a paracentesis of the anterior chamber for the sake of removing pus, then why should we approve of a paracentesis of the drum cavity for an acute inflammatory process of the middle ear."

In the next five years, 1870 to 1875, we find that paracentesis became a popular method of treatment for acute suppurative otitis media. Many cases of acute inflammation of the middle ear treated by puncture of the drumhead are briefly recorded, but otolaryngologists continued to feel their way carefully in the treatment of temporal bone infections; because we note that when signs and symptoms of acute mastoiditis appeared surgical efforts consisted only of an incision made through the skin down to the mastoid, about one inch in length, one-half an inch behind and parallel to the attachment of the auricle. Obviously such a procedure was helpful in those neglected cases where the infection had perforated the mastoid cortex and had become active under the periosteum of the mastoid process. From ignorance of surgical techniques and in part, too, from the lack of courage,

operations for acute mastoiditis were limited to a soft tissue incision and drainage.

The surgeons were soon to become bolder, however, because in 1879, a successful operation for acute mastoiditis is reported by opening the cortex of the mastoid bone. Dr. A. G. Gerster, a surgeon at the German Hospital and Dispensary, New York City, stated that he was describing this case in the literature "to encourage others to prompt action in similar instances." The operator deprecated the use of such instruments as the trocar and trepan because they could not be kept under observation and were, therefore, unsafe. He reports that "the employment of the chisel and mallet seems to offer the greatest security. Several advantages will accrue if the action of the chisel is tangential to the surface of the cranium: first, the bone will be opened layer by layer and thus laceration of the transverse sinus be best avoided; second, the cavity of the abscess is converted into a shallow basin that will afford excellent drainage."

Schwartze had previously perforated the mastoid process with a drill, but because he had been repeatedly deluded in his expectation of finding pus, there were often indications for a more extensive excavation of the mastoid process with chisel and spoon. In nearly all instances, however, we find that an operation upon the mastoid process was delayed while conservative measures were employed, particularly the application of leeches to the edematus, swollen mastoid region.

We find in the literature of this period an appreciation on the part of otolaryngologists of functional ear diseases. The profession is cautioned about the possibility of psychic conditions being reflected in the form of pain to the region of the ear and a warning is sounded not to interfere surgically with these patients. We read that "if the patient bears his pain badly, suffers from great depression of spirit, dwells to an extreme upon his illness, and is generally so much taken up with the severity of his pain as to have room for nothing else, we would hesitate to perform a surgical operation, no matter how trivial it may be." The author goes on to say further, "We have no right, I think, to perform operations to

clear up doubtful diagnoses; if in case the operation proves to have been unnecessary, the patient will be decidedly the worse for it." His admonition is given pedagogical emphasis when he states that "in teaching medical students, I have always found them, when fully awakened to the danger of neglecting certain diseases, to be more apt to do too much than too little, especially with the knife and active drugs."

The importance of this warning has become no less significant today than when it was expressed in 1879. The unending moral obligation of the profession to avoid surgical measures for diagnostic purposes and in patients with obvious psychogenic disturbances continues, I fear, to be treated lightly today. We have come a long way in the development of surgical judgment since the above quotation was written, but there is more to be learned and moral assessments to be made if we are to rank highly in the judgment of our professional colleagues.

It must be recorded that, in 1876, Hartman opened the mastoid process through the external auditory canal with a drill. This was an early demonstration of the end-aural approach. Schwartze spoke most sharply against this technique because, as he warned, we then "drill into the darkness." Its advocates countered, however, by reciting the time-honored axiom that "when we become well acquainted with the anatomical relations many things will be illuminated that are now dark to us."

In the early 80's we discover that the nose and throat are beginning to attract attention and that the otolaryngologists of the day are advocating operations for the removal of hypertrophied adenoids and tonsils and the relief of nasal obstruction. The galvano cautery is recommended for the reduction of hypertrophied tonsils. The tonsil was gradually burned until the remaining portion was on a level with the palatine folds. One or two areas were cauterized at each sitting and usually only one tonsil was operated upon at a time. From 12 to 30 sittings were required to complete the process and operators freely admitted that they noticed a disagreeable odor from

sloughs and an impairment of appetite in consequence of their surgical efforts.

Other members of the profession questioned the utility of the galvano cautery, emphasizing the difficulties in the case of a struggling child who could not be induced to have a second sitting after the first painful experience. The dangers of ether in the presence of the galvano cautery were recognized and local anesthesia had not yet received popular approbation by the profession. Tonsillotomy was favored by many operators. The proponents of this procedure agreed that if they removed a thin slice of the gland they did no good whatever; but, on the other hand, if more were removed, grave hemorrhage might occur. One author explains that "too often this fact is applied as a sop to the conscience of timid operators and as an excuse for an incomplete operation. We should come down to the level of the pillars of the fossae, but, on the other hand, we should not enucleate. The operations should be done with the tonsillotome; with bistoury there is greater risk of hemorrhage."

The submucous resection of the septum was preceded by an incredible number of destructive intranasal procedures, turbinates were sacrificed, the galvano cautery was used with subsequent stenosis and a variety of crushing procedures recommended to straighten the septum. One wonders why the simple yet most widely employed and singularly successful intranasal operation, the submucous resection of the septum, remained undiscovered until the turn of the century. In a most comprehensive paper presented at the Fifty-sixth Annual Session of the American Medical Association in 1905, Dr. Otto T. Freer described the operation for submucous resection of the septum. The pervasive popularity and use of this operation seem to have been established shortly after this date.

Total extirpation of the larynx must have been a futile and discouraging operation in this period (the 1880's). Patrick Heron Watson, of Edinburgh, was the first to demonstrate the practicability of the operation, in 1866, by performing it upon a patient, although the result was fatal, due to a postoperative pneumonia. In 1883, Dillroth performed laryngec-

tomy at Vienna in sufficient numbers and with a degree of success that might entitle him to the credit of having made the operation a feasible procedure. The statistics of this age on total extirpation of the larynx for malignant disease are appalling. A table published in the *Journal of Laryngology and Rhinology*, in 1887, records 103 cases. Forty died from the immediate effects of the operation, others succumbed from inanition, pericarditis, lung abscess and septicemia within a few months, until in the end there is recorded in this series only nine out of 103 patients living 12 months after the operation. Despite these grievous results, laryngectomy had ardent supporters in the 1880's. Many from the ranks of our specialty continued to study this problem and strove diligently to solve it. They met the challenge and through unity of thought and agreement directed a nonemotional approach to the various phases of this affliction and eventually established practical surgical procedures for the eradication of malignancy of the larynx. When one is reminded that for nearly three-fourths of a century leading apostles of laryngology have directed opinions to the real issues of laryngeal malignancy and tackled the job of surgical intervention step by step to find a cure, he is skeptical of the claims of success today made by the X-ray therapist of limited experience in this field. Too frequently surgical measures are unnecessarily delayed in the hope that palliative procedures will eradicate the disease. X-ray therapy is useful, but it bears a minor relation to that conviction which governs my principles of procedure; namely, the necessity of operative interference when the larynx is the seat of an operable cancer. I am unwilling to compromise with any other recommendation, and I hold the opinion that in most instances it is the most charitable method of treatment, in that it minimizes suffering and gives greater assurances of longer survival.

While ether and chloroform had been used for approximately 50 years, we find considerable acrimonious dispute in the early 1890's in regard to the comparative toxicity of these two agents. Many of the hospitals in this country, even the large institutions in metropolitan areas, had failed to keep records, so that it was exceedingly difficult to compile statis-

tics on the comparative advantages or disadvantages of ether and chloroform. As late as 1890, opinions gained from meager experience gave rise to the statement in some quarters that ether and chloroform were equally safe. It was generally agreed, however, that more dangerous symptoms had occurred when chloroform was used and that this anesthetic should be employed in "strong patients or when brain and kidney diseases were present." Ether was advocated for "weak persons," but hospital records seem to indicate that chloroform was the anesthetic usually selected, probably because of its rapid action and failure as yet to appreciate its dangers.

An important advance in otolaryngology was the recognition and treatment of septic thrombosis of the cranial sinuses, resulting from suppurative disease of the middle ear and mastoid. To Zausal, of Prague, must be given the credit for the first therapeutic recommendation, in 1880. He performed a ligation of the internal jugular vein, in 1884, but his patient did not survive. Horsley, of London, quite unaware of any previous effort to accomplish this technique, ligated the jugular vein, in 1888, but his patient also met a fatal termination. The same year, Lane, of England, and Hoffman, of Germany, repeated the procedure previously recommended and were rewarded by successful results in both patients. When, in 1889 to 1890, Ballance, of London, reported four cases with two recoveries, the operation was enthusiastically received by the profession and became a universal procedure in all countries where modern medicine was practiced.

In the years that followed until the advent of chemotherapy and the antibiotics, a controversial issue was whether the operation should be restricted to a simple removal of the septic thrombus from the sigmoid sinus or extended to include a ligation or even a resection of the internal jugular vein. As far as I am aware, this dispute was never settled to the satisfaction of the otolaryngological profession. It has obviously ceased to be an issue, however, since the incidence of lateral sinus thrombosis is infrequent and specific therapeutic measures are at our disposal. Although some impressive

anatomical studies have demonstrated that there is a dense venous drainage through the tributaries of the jugular bulb and vein, and for this reason there was justification for skepticism concerning the effectiveness of jugular vein ligation, the operation, nevertheless, was frequently followed by phenomenal improvement of the patient. It seemed to be another instance of a septic process failing to follow the course anticipated from a study of practical anatomical considerations.

With the turn of the century we note that otolaryngologists in this country were performing complete operations upon the nasal accessory sinuses and instituting principles of sinus surgery which are recognized as those accepted today. The technique which they advocated called for the complete eradication of all the diseased processes, the meticulous removal of the lining mucous membrane of the sinus, whether it be the maxillary, ethmoid, frontal or sphenoidal sinuses; the obliteration or maintenance of permanent drainage of the sinus cavity. Modern surgery is making more skillful approaches to the sinuses, reducing deformities to the minimum, and embellishing the techniques in some of their minor aspects; nevertheless, in the early 1900's the fundamental principles of sinus surgery were as well recognized and executed as they are by the surgeons of today. When the otolaryngologist's ingenuity failed him, and this seemed to have occurred many years ago, in surgery of the nasal accessory sinuses, he turned to the adornment of technical methods. The latter enriches the beauty of technique and enhances the interest of operators of varying degrees of skill, but the end-results in terms of service to the patient have gained nothing that was not accomplished by the procedures advocated and performed four decades ago.

We might span the period of 20 years from 1910 to 1930 by a simple glossary of significant otolaryngological advances. At the beginning of this period the value of Roentgenology in otolaryngology was called to the attention of the American specialists. It was emphasized that the Roentgenological diagnosis of sinusitis was based on the principle that the rays "passing through a bony cavity filled with air gives the

contrasting outline which is sufficiently different from that obtained when the air is replaced by secretion or granulation tissue." The Roentgenologist was warned, however, that he "should not be tempted too far beyond this basic fact in his diagnostic ardor." It was emphasized then as it is today that close collaboration between the otolaryngologist and the Roentgenologist would be productive of mutual understanding and consequent effective service to the patient.

About this time we are urged to give serious consideration to the faucial tonsils as a gateway to general infection. It was believed that many general infections developed from acute and chronic inflammatory disease of the tonsils and that tonsillectomy was indicated in pericarditis, myocarditis, endocarditis, arthritis, chorea, neuritis, pleurisy, tuberculosis, iritis, phlebitis, osteomyelitis. Hodgkin's disease and possibly certain forms of leucemia. The pendulum of enthusiasm obviously swung too far, and it required years of observation and study to prove that all these infections could not be charged to a tonsillar origin. This wave of interest in tonsillar sepsis probably had its virtues, however, in that it made the otolaryngological profession cognizant of the fact that the lymphoid tissue of the pharynx is sometimes the portal of entry for the infections which produce swollen joints and damage the heart and kidneys.

For many years indirect laryngoscopy had been advocated. In 1914 we were urged to use the direct method, in that it was a practicable procedure for children, overcame the handicap of the reversal of the image in a mirror, and could be employed for operative procedures under general anesthesia.

The possibilities and limitations of suspension laryngoscopy were described in 1916. It found favor in many clinics because it immobilized the patient and allowed freedom of both hands of the operator. About this same time the guillotine for tonsillectomy was recommended because of its speed, better cosmetic results, less bleeding, performance by the sense of touch and its practicability under nitrous oxide anesthesia.

In 1917, otolaryngologists were becoming apprehensive about the development of acute pulmonary abscesses, occurring after operative procedures on the upper air tract. Numerous explanations for this grave complication were offered, including hematogenous and lymphogenous spread of infection. It is a significant fact, however, that improved methods of anesthesia and adequate suction of the operative fields have greatly reduced the incidence of this hazard. Direct gravitation of infected material into the lower air passages must have been the responsible influence in most of these cases.

In the period from 1910 to 1930 I am impressed by the fads and fancies in otolaryngology. Might it not be truthfully stated that eye complications arising from diseases of the nasal accessory sinuses, particularly iritis, choroiditis and retrobulbar optice neuritis, were overemphasized. Did we not stress too radically the occurrence of sinusitis in infants and children and perform many unnecessary operations upon patients in the early years of their growth? Were we not led astray by the presumption that asthma was the result of a nasal reflex and that radical operations upon the nasal accessory sinuses for the removal of polypoid disease were curative measures? It is doubtful that there are any votaries of this theory today. Time and experience have obviously placed them in an ignominious position, because the contentions of 1930 in regard to the relation of asthma and chronic sinusitis have not been sustained. Convictions of the existence of a sphenopalatine ganglion syndrome were fleeting; early opinions on the advantages and disadvantages of the various local anesthetics in the nose and throat have not stood the test of clinical and pharmacological investigation, and the occurrence of deafness in patients with vitamin deficiencies has not been substantiated by scientific studies of an acceptable character. While these may have been some of the whims of the profession, they perhaps had their virtues, in that they evoked academic interest and in some instances gave rise to theories which were reduced to facts for practical usage in otolaryngology.

To French radiologists belongs the credit of the first use of lipiodol and its introduction to Roentgenologic practice. About 1927, the employment of a radiopaque substance in the visualization of the lower air passages was established in this country as an aid to the diagnosis of bronchial and pulmonary disease. It opened a wide field of study from both a diagnostic point of view and for the teaching of practical anatomy.

In the literature of the 1920's we observe a growing interest in hay fever and the clinical manifestations of allergy. The cutaneous or scratch tests of testing patients for pollen reactions were gaining favor and thorough surveys of botanical flora were being made at certain seasons of the year in many parts of the country. It was the beginning of a specialty in which reputations were to be made and yeoman service rendered to patients afflicted with a condition that heretofore had resisted all forms of local therapy.

In 1922, our attention was called to the disease, agranulocytic angina, although the etiological influences responsible for this condition were not understood. Attempts to find a specific organism invariably failed. The condition of the bone marrow, however, gave some evidence that the disease was probably due to a toxin that destroyed the granulocytic blood cells and inhibited the blood-forming centers of the bone marrow. My memory is still vivid of several tragic cases seen on our wards about this time; patients with agranulocytic angina to whom repeated doses of pyramidon were administered for headache and general discomfort.

Until this period of the 1920's, our popular textbooks had taught that primary carcinoma of the lung was exceedingly rare. Improved instruments and bronchoscopic technique were beginning to demonstrate that this condition was by no means as rare as formerly stated. In the previous decade the diagnosis had been made at autopsy; now we were beginning to observe the true identity of the lesion through the bronchoscope. There seems little doubt now that we are experiencing an actual increase in malignancy of the lung

and not a relative one, due to more precise methods of diagnosis.

A better understanding of acute suppurations of the mediastinum and the procedure of cervical mediastinotomy greatly reduced the mortality from this disease in the late 1920's. In 1931, petrositis was revealed as an entity and understood both in regard to the pathology of spread of the infection and the technical procedures for adequate drainage. It should be regarded one of the great contributions to otology; a savior of suffering and lives from the period of the early 1930's to the advent of chemotherapy and the introduction of the antibiotics.

Although modern otolaryngology may be said to have antedated the advent of chemotherapy, it must be admitted that the introduction of the sulfonamides gave rise to a changed point of view in respect to the practice of our specialty. Proof of this fact was the often repeated statement by authorities that chapters in our textbooks would need to be rewritten. We observed an abrupt shift from discussions of inflammatory processes to such studies as the physiology of the nose, neurological lesions which influence the various senses, plastic surgery, the embryological derivations of tumors and cysts and noteworthy investigations of disturbances of the auditory function and the facial nerves.

Important advances have been made within recent years in our understanding of Ménière's disease. We now recognize it to be a hydrops of the otic labyrinth, a condition which occasionally responds satisfactorily to different forms of medical therapy. No doubt, too, it is prone in some instances to undergo spontaneous intermissions or remissions. Surgical procedures upon the labyrinth, as for example, decompression and electrocoagulation, have given results of promise equal to those obtained from a subtotal section of the auditory nerve.

We have experienced two World Wars within the past 100 years, but a review of otolaryngological practice during both of them leaves one with the impression that noteworthy

accomplishments were not conspicuous by their number. This is to be expected when one recalls that most otolaryngological staffs in various teaching centers were greatly reduced by a call to military service, and the personnel which remained in civilian practice were overwhelmed by routine responsibilities in the care of the sick. More significant perhaps is the fact that special emphasis was placed upon fields of research which did not fall within the province of otolaryngology. The recent war demanded that particular attention be given to investigations pertaining to the prevention and treatment of infectious diseases, the care of the wounded, psychiatric disturbances and physiologic problems which arose as the result of placing individuals in abnormal environments.

In spite of the rather undignified position our specialty assumed in military service, and in spite of the fact that otolaryngologists in general were subordinated to other professional personnel in the Army, the members of our profession saw their responsibilities and gave their unfailing support to the job at hand. One evidence of devotion was seen in aviation medicine. The influence of radium in the prevention and treatment of anomalies of pressure within the middle ear was well known prior to the war and it remained, therefore, for members of our specialty to recognize its indications and to employ it effectively in conditions occurring among aviation personnel.

Nerve grafting and nerve anastomosis attracted the interest of members of our profession and led to the development of surgical techniques more practicable in their application and productive of greater success than attained at any previous time. Men fundamentally trained in the anatomy and pathology of the temporal bone led the way to memorable progress in this field.

In the study of acoustic trauma, interesting advances were made during the war by representatives from our ranks. While injury to the auditory function did not become a problem of great magnitude, it must be granted that otolaryngologists were quick to respond to the request from military authorities for a better understanding of this condition.

I point with pride and with a deep sense of gratitude to those farsighted and efficient otolaryngologists in military service who created an epochal program of service in the Army and Navy centers for the rehabilitation of the hard of hearing. They achieved phenomenal progress and rendered a service that will go down in history as one of the brilliant examples of humanitarian efficiency during the war. Advances among civic agencies are usually conspicuous by delay, but I venture the opinion that the impetus given this magnificent program of service to the hard of hearing by military personnel is destined to inspire if not demand a similar plan of action in civilian life.

It is encouraging to observe within the past decade that our profession is endeavoring to offer something more to the public than elaborate programs of prevention and expansive statistical compilations in the field of impaired hearing. Otolaryngologists and workers in the acoustic sciences are now wisely directing attention to the significant problems of deafness and formulating programs of therapy which give promise of real service to the hard of hearing. Thanks to recent studies, otolaryngologists are now equipped with the means of producing an atrophy and retrogression of lymphoid tissue responsible for anomalies of pressure within the middle ear. The use of radium in this type of deafness is an epoch in the progress of therapy and gives hope of saving or restoring serviceable hearing to children in whom the pathological changes in the tympanum are due to an occlusion of the Eustachian tubes by lymphoid tissue.

It seems to me that there is justification for the present widespread interest in the surgical treatment of otosclerosis. The one-stage operation stands today as the only therapeutic measure which has been of service to patients with this disease. The fenestration operation constitutes a magnificent contribution to this field, not only because it has given serviceable hearing to some of the unfortunate victims of otosclerosis but for the reason, too, that it has inspired a deeper interest in the anatomy of the temporal bone and brought together some sincere and intelligent persons from the ranks

of the medical sciences to study this problem and find its solution. From this operation, observations have been made and theories have been derived. There is a good chance that by further careful experimentation some of these theories will be reduced to facts.

I cannot pass by without mention of the noteworthy progress our specialty has made in the training of young men in otolaryngology. Education above the level of undergraduate studies is not only a mark of the medical profession but also a significant requirement that has assumed increasing importance with the evolution of American medicine. Its progress has not been rapid nor has it yet achieved exemplary objectives; nevertheless, it has developed resolutely into an essential program that demands the attention of all graduates of medicine today.

Most of us can remember that less than three decades ago the general rotation interneship was not considered essential to the practice of medicine, nor was it required for licensure by our State Boards of Registration. Today, no young graduate would attempt medical practice without at least one year of interneship, nor would the young doctor venture to apply for the study of a specialty without completing the interne year, because he knows that this requirement is imposed by all reputable medical schools and departments in this country. Thus we find that the rapid progress which medicine has made in recent years, particularly its advances in the field of specialization, has initiated a public demand for technical skills and specialized capabilities that can be furnished only by the individual who keeps in stride with continuing education throughout his lifetime of useful service.

One of our greatest advances in the education of the otolaryngologist has been the establishment of curricula of continuing study which offer training to staff members for a three-, four- or even five-year period. In these groups there are students of varying degrees of experience and skill who transmit their knowledge of the subject to those whom they outrank and receive instruction in turn from the superior officers on the staff. Thus each member of the group assumes

the function of an instructor and the responsibilities thus imposed upon him are invariably followed by a diligent search for knowledge and information which he may pass on to those whom he is expected to serve.

Let me warn that the otolaryngologist of today must assume certain educational responsibilities before he commences the practice of his specialty. He must be thoroughly trained in the principles of surgery, newer surgical techniques, protein metabolism, the recognition and treatment of shock, the value of early ambulation, methods of resuscitation therapy, and the use of modern anesthetics, if he is to practice surgery of the head and neck with credit to himself and safety to his patient. Recent progress in surgery has demonstrated that the preparation of the patient has much to do with the manner in which he tolerates a surgical insult and his behavior during the period of convalescence. Too much emphasis cannot be placed upon the protein requirements of the surgical patient. The degree and rate of tissue repair are tremendously influenced by the amino-acids, and any patient who is a victim of their impoverishment is destined to react poorly to a major surgical procedure.

Experience during the war taught us that the best treatment for blood loss was a transfusion of whole blood. Chemotherapy and penicillin when intelligently used were great saviors of life and limb, but they were no substitutes for operations properly performed. These agents are not a compromise for a poor operation, and anyone who believes that the sulfonamides used locally will compensate for mediocrity in the operating room is certain to be disillusioned. The trend now is definitely against the introduction of the chemotherapeutic agents directly into a wound.

Throughout this discussion there has been a great temptation to quote from numerous references and to pose the viewpoints of many otolaryngologists who have made creditable contributions to the literature. I wish it might have been possible to pay tribute to our living contributors and to do justice to them by expressing their critical judgments,

but time obviously would not permit such an encyclopedic survey of the past century of otolaryngology. Unquestionably, I have overlooked many important and significant advances during this period. If I have failed in some instances to give correct dates, it is because I have not tried to identify the time of ideas and concepts; rather, have I endeavored to date the periods of changing trends and the practical application of them. If there is any justification for this long review, I hope it may be found in a deeper appreciation of the indomitable spirit and devotion of our forefathers and a motivation to the young men of today in whose hands the fate of otolaryngology is held to strive even more sedulously for future progress.

LARYNGOCELE—REPORT OF A CASE.

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So few instances of laryngocele are on record in the literature that there seems justification for reporting at this time a case recently observed in the writer's private practice. Recent articles,[1,2,3] however, have gone so thoroughly into the condition that there is little justification for extended comment.

CASE REPORT.

L. B., a 38-year-old white man, had been aware for the past month of the presence of a mass about the size of a walnut on the left side of the neck. There were no symptoms connected with its presence. Coughing had no effect on its size, but it enlarged when the patient swallowed voluntarily.

Physical examination revealed nothing of importance except for chronically infected tonsils and a mass about 2.5 cm. by 3 cm. on the left side of the neck, in the region of the anterior superior cervical triangle. It was soft and compressible, showed no signs of inflammation, was not tender on palpation, and increased in size only on swallowing. Percussion elicited a tympanitic note.

A tentative diagnosis of an external superior lateral laryngocele was made, but indirect and direct laryngoscopy revealed no abnormalities and all attempts to locate any opening in the larynx were futile. Pressure over the mass resulted in no change in size.

The patient was referred for fluoroscopic and Roentgenologic examination (see Fig. 1) to Dr. Dorothy Mattingly, who made the following report:

Views of the cervical region show an air pocket measuring 2 by 2.5 cm. in the left upper cervical region. Fluoroscopic examination shows increases in the size of the pocket while the patient swallows or holds his breath. No defect of the esophagus is apparent. Impression: Laryngocele.

Because the laryngocele could be inflated only while the patient voluntarily swallowed several times, it was recommended that the sac be excised under local analgesia, so that he could cooperate during the procedure. The patient accepted surgery but declined to be operated on except under a general anesthesia. Intratracheal cyclopropane oxygen anesthesia

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was therefore employed. An incision was made approximately one inch below the border of the left mandible, extending from the angle of the jaw almost to the midline. When the platysma muscle and the deep fascia were incised, the laryngocele came into view. The capsule was just anterior to the sternocleidomastoid muscle and just under the submaxillary

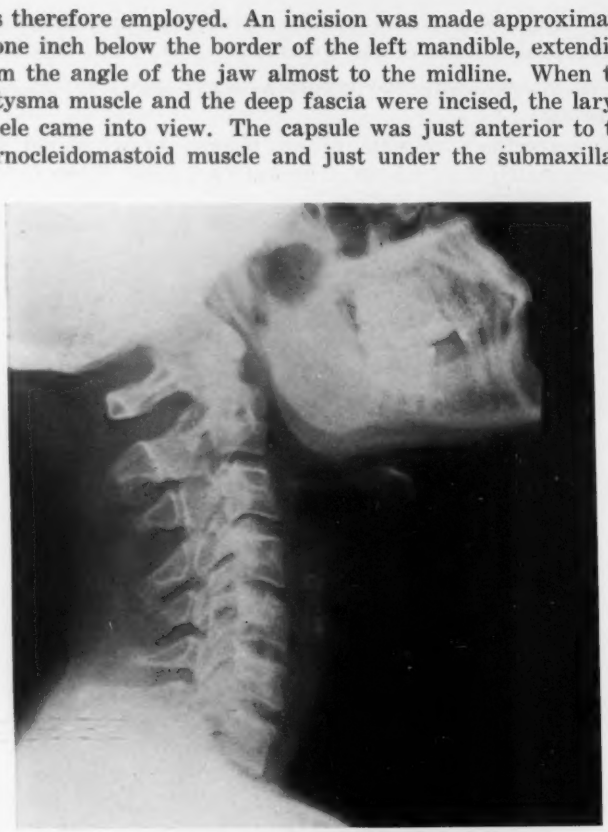

Fig. 1.

Figs. 1 and 1A. Preoperative Roentgenogram of left external superior lateral laryngocele.

gland. In the course of sharp dissection the sac was inadvertently punctured; it contained air and about 4 cc. of yellowish, nonpurulent fluid. The sac was traced to its attachment to the thyrohyoid membrane in the midline, just above the superior border of the thyroid cartilage. It was excised at this point, the stump being tied with heavy silk.

The wound was closed in layers, without drainage, with interrupted sutures of No. 0 chromic.

The excised tissue was reported on as follows by Dr. John L. Beven:

The specimen consists of an oblong, brownish-red sac, approximately 3 by 1.5 cm. The walls are thin. When the sac

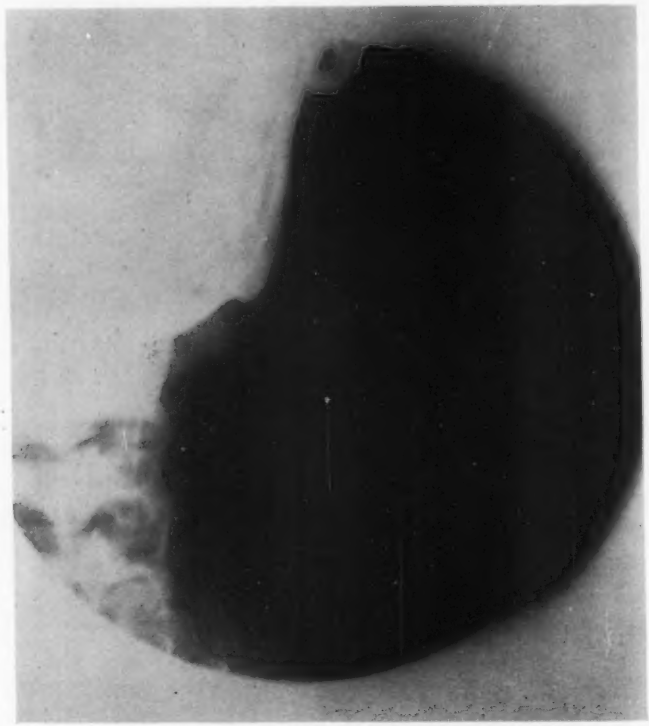

Fig. 1a.

is opened it is seen to be lined with a smooth membrane containing several petechiae.

Histologic examination shows an outer layer of fibrous connective tissue containing blood vessels and an inner layer of stratified squamous epithelium. There is an infiltration

of lymphocytes and plasma cells, with a few leucocytes, throughout the sections examined.

Conclusion: Cyst showing chronic inflammatory changes.

The postoperative course was completely uneventful, and the patient is perfectly well at the time of writing (nine months after operation).

Roentgenologic examination (see Fig. 2) six months after

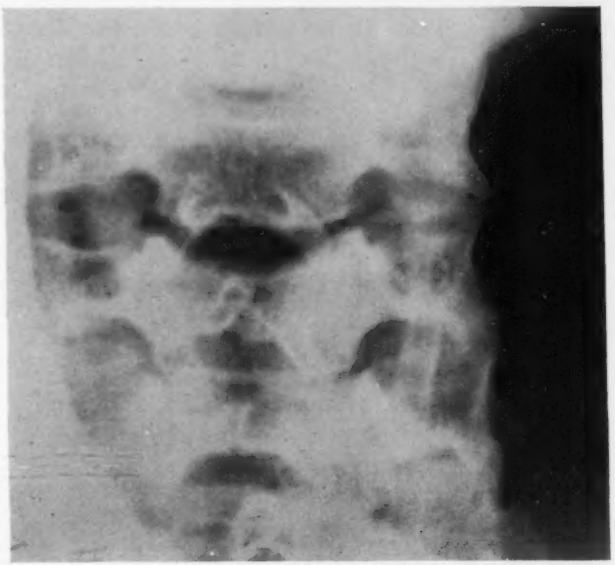

Fig. 2. Roentgenogram of left cervical region following resection of laryngocele.

operation showed no evidence of the air pocket previously seen in the left upper cervical region and no abnormalities of the soft tissues.

COMMENT.

The number of cases of laryngocele on record in the literature has been confused by the fact that several observers,

citing Moore's[4] extensive study of prolapse of the laryngeal ventricle and eversion of the sacculus, have attributed to him a collection of 85 cases. Actually, he mentioned only 11 cases of laryngocele (not 10, as some articles on the subject state), and from the fact that he headed the collection, "Some Recorded Cases of Laryngoceles," one has the impression that he did not search the literature thoroughly. He mentioned, but did not enlarge on, Hansberg's statement that up to 1913, 24 cases had been reported; all of the cases on which he, himself, commented were recorded prior to that date and presumably were included in Hansberg's collection. The case reported before the Royal Society of Medicine, Section on Laryngology, by Spicer in 1920, as a laryngocele, which inspired Moore's own researches on the subject, was finally, after what seems to have been a rather vigorous discussion, classified a year later as a hernia of the sacculus. I have attempted no complete review of the literature, but a casual survey indicates that up to the present time in the neighborhood of 40 cases have been recorded. Most reports concern single cases only, but Gruber, according to Moore, described two specimens in the Museum at Munich and recorded at different times, between 1874 and 1879, four cases which he had observed personally.

The term laryngocele, as Moore[4] noted, was introduced by Virchow, who wrote:

> I have found a dilatation of the ventricle of Morgagni, up to the present unknown as it seems, which one may call "ventricular laryngocele." One sees, in these cases, small elongated sacs with thin walls, coming off from the upper part of the ventricles by a somewhat narrow orifice, and sometimes reaching to the upper border of the thyroid cartilage, and even to the hyoid bone, where they terminate by an end in the form of a club. . . . Their walls are smooth, their interior is lined with ciliated epithelium, and they are filled with air.

Because anatomic specimens are few (although three of the 11 recorded cases discussed by Moore were in the form of specimens) not a great deal is known about the pathogenesis or pathology of laryngocele. Apparently, as Lindsey[1] points out, there are three possible categories: *1.* Internal laryngocele, the most common variety, is a cystic dilatation which develops within the larynx and which may extend to

the aryepiglottic folds or even the base of the tongue. *2.* External superior laryngocele is a cystic dilatation of the ventricle of Morgagni which has penetrated the thyrohyoid membrane just above the upper rim of the thyroid cartilage anterior to the superior cornu or just lateral to the thyroid notch. The case reported in this communication belongs in this category. *3.* A combination of Types 1 and 2. Associated carcinoma was reported by Schall[5] and suppuration by Lathrop.[6] In the case which I am reporting, fluid as well as air was present in the sac and the pathologist reported inflammatory changes.

The etiology of laryngocele remains to be clarified. It has been attributed to such factors as excessive use of the voice; occupations that require excessive respiratory effort, such as glass-blowing and playing of wind instruments; occupations that require excessive use of the upper extremities, such as lifting of weights and similar physical exertions; straining at stool, straining during childbirth, and similar efforts; violent coughing, as in whooping cough; exaggerated efforts to swallow; and numerous similar causes. Obviously all such explanations are inadequate, if only because all of the factors mentioned are extremely common, while laryngocele is extremely uncommon. In numerous reported cases, as in the case reported herewith, there was no evident etiologic factor.

It is now the opinion of most observers that laryngocele is not an acquired lesion, as was once believed, but that it arises in a congenitally long ventricular appendix and becomes evident when for some reason intratracheal pressure is increased. Allman and Corday[7] have advanced the theory of inadequate embryologic development, and Taylor[2] presented the phylogenetic aspects of the condition. When once a laryngocele has developed, any of the various factors advanced as explanations of the condition can be responsible for an increase in the size of the sac.

The patient often consults a physician, as in my own case, merely because of the presence of the mass. More often there are voice changes. Lathrop's[6] patient was told of the change in his voice by friends; he had not noticed it himself. Wheel-

er's[8] patient sought medical aid because his friends could not understand what he said; this patient, incidentally, died under ether anesthesia before the operation had been started. Large laryngoceles may cause dyspnea.

Diagnosis is by identification of a sac in the appropriate location. It can usually be made to decrease in size by pressure, the decrease being accompanied by the hissing sound of escaping air. This phenomenon was not observed in my own case, probably because of the presence of fluid as well as air. There is usually a tympanitic note on percussion. Clinical diagnosis is confirmed by X-ray examination, which shows a sac filled with air. Treatment is surgical excision.

SUMMARY.

A case of laryngocele is reported and certain aspects of the condition are briefly commented on.

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THE PROBLEMS OF TINNITUS IN THE PRACTICE OF OTOLARYNGOLOGY.

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The first and most important point about *tinnitus aurium* is that it still remains a problem or a question to be solved.

From the writer's own experience and from the evidence of all the reports in the literature on this subject, in which its innumerable manifestations are described, the conclusion must be that tinnitus is not to be considered a disease entity but an abnormal sensation in the field of hearing, and a symptom which results from a great number of causes, in very many conditions, which may or may not be primarily concerned with the hearing apparatus itself.

What one chooses to name this manifestation is not of importance if it is clear that the words *tinnitus aurium*, which literally means ringing in the ear, are being used to include all of the various sounds which may be heard in this condition. Because of the great variety of these sounds, the term head noises would seem preferable; the more so since the sounds may be perceived when the hearing apparatus itself has completely lost its function.

The general statement has been made that everyone, including all normal hearing persons, have head noises, which are masked by noises from outside. This idea may have been derived from a statement attributed to Fletcher, that "a high normal ear" is capable of hearing a faint noise when in a soundproof room, which is due to the "jostling of the molecules" which are ever present in the surrounding air, and that it is a normal phenomenon. This is of particular interest in the consideration of head noises, and possibly of considerable importance in contributing to a clearer understanding of them. The value of such a statement is limited

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without considerable clarification and consideration. It will be referred to later in this paper.

Since the interest here is mainly clinical, the following cases are presented briefly to illustrate the diversity of conditions in which head noises have been encountered by the writer during years of practice in nose, ear and throat medicine.

Case 1: Male, 42 years. Came primarily for corrective surgery of the nose, but complained of deafness and tinnitus in the left ear of four months' duration, worse at night. The noises were described as low and rumbling, sometimes like a distant fog horn, which changed occasionally to sound like a waterfall. There was an associated sensation of fullness in the left ear. The entire syndrome was increased at the end of a day of hard work. Examination revealed a deflected nasal septum which was corrected and a submucous resection was done to increase the ventilation of the left Eustachian tube. The head noises diminished, with periods of entire absence.

Case 2: Female, 55 years. Housework. Came for constant buzzing in the left ear, present for the past 22 years. The nose and ears were found free from abnormalities, except that the left eardrum was retracted and through the upper part of the transparent membrane a purplish-colored area could be seen. On placing a stethoscope over the ear, a vascular type of sound could be distinctly heard, similar to that present in aneurysm. This sound was synchronous with the heart sounds. A diagnosis was made of an aneurysm of a small aberrant branch of the carotid artery.

Case 3: Male, 32 years. Had been in military service. Following artillery fire, he noticed a sudden ringing in his left ear, which has been constant, but sometimes changes to a hissing sound. Hearing had grown progressively less acute. No gross abnormality was found on examination.

Case 4: Male, 39 years. Complaint was of constant noises in the left ear, like a steam whistle, accompanied by severe vertigo. A shipyard worker, he attributes his trouble to the noisy surroundings. General physical examination, including blood serology, was negative. Audiometer test showed total nerve deafness in the left ear, with impaired hearing in the right.

Case 5: Male, 74 years. Complained of constant buzzing in both ears, with an occasional sound like a pistol shot. The noises were so extreme that it was not possible to "mask" them with the radio, and the use of headphone attachment made the situation worse. Examination showed reduction in hearing on both sides, greater in degree on the left. The diagnosis was chronic progressive deafness, mixed type. Shortly after the patient was at the office, an emergency call was received, which proved to be for an attempt at suicide by the patient. He had taken 12 capsules of seconal, but was saved by prompt use of the stomach pump. The case illustrates the seriousness in some instances of constant severe head noises.

Discussion: The observation has been made that head noises are still heard after the activity of the cochlear nerve has been completely destroyed. This fact suggests that an

irritation (stimulation) of the central portion of the auditory system may be perceived as sound of the nature of head noises, in a manner similar to the perception of touch and pain, when the corresponding cortical brain areas, or subcortical fibre tracts, are stimulated. This should not be confused with what has been called "psychogenic tinnitus," since it would be entirely sensory. The expression "cryptogenic tinnitus" might be clarified on this basis.

Functional Anatomy: The structure of the inner ear is particularly suited to respond to internal as well as external origin. The organ of Corti, which is regarded as the essential sensory organ of hearing, is surrounded by an aqueous fluid of viscosity suitable to transmit a wide range of vibrations.

The manner of production of the endolymph is not known, but it is considered possible that it is a dialysate from the capillary tuft (stria vascularis) in the cochlea, near the organ of Corti, and analogous to the cerebrospinal fluid of the central nervous system and of the aqueous humor of the eye. In neither of the latter instances is the source of these fluids definitely known. Authoritative experiment on the circulation of fluid within the eye has demonstrated that there is direct communication with the submeningeal fluid of the brain. It does not appear that the possibility of a similar relation has received consideration, between the cerebrospinal fluid of the brain and the lymph fluid of the internal ear.

A simple demonstration of the effectiveness of water as a conductor in deafness can be seen in the following example. If a deaf person, unable to hear the drippng of water into a filled basin will immerse the head within this water-filled basin, the sound of the dripping, which is inaudible by air, will be heard with ease. This concerns bone conduction also, but of a sound which would not reach its threshold without the amplification of the water bath.

This subject leads indirectly back to the question of Fletcher's statement that a "high normal ear" is able to hear the "jostling of molecules" in a soundproof room. In considering this interesting idea, a question arises which may seem some-

what irrelevant, but which may actually not be so: what determines the acuity of such a "high normal ear," and is it possible that such an ear would, in a less normal general bodily condition be more apt than others to be subject to what is called tinnitus? Another question requiring attention is whether such an ear would be more apt to hear the jostling of molecules than the impact of the circulating blood in the capillaries surrounding the organ of Corti. One might even enter so far into the field of theory as to ask whether those with "high normal ears" also have abnormally sensitive autonomic nervous system reactions and whether they have been studied from the standpoint of fine changes of blood pressure under slight stimulation, of a suitable type. One would be justified also in asking about the air in the soundproof room; especially concerning its oxygen content, or whether the room was air-conditioned. Some persons react very considerably to both, with increase in relative intracranial capillary tension, which is roughly indicated by a feeling of fullness in the head and injection of the skin of the face.

These conditions might well influence not only the impulse of the intracapillary blood stream of the internal ear but also alter both the amount and the viscosity of the surrounding lymph fluid.

The difficulties of determining the answers to all questions concerning the internal ear are evident, but this fact does not lessen the importance of their consideration in relation to a subject so surrounded by obscurity as that of head noises. Some of these phenomena might possibly be studied by animal experiment, and light might be thrown on some others perhaps during fenestration operation.

The fact is also worthy of notice that the VIIIth nerve, somewhat like the olfactory and optic nerves, does not have the same structure as the true peripheral nerves. These three nerves all have characteristics of central nervous tissues, and the organ of Corti, like the retina of the eye, may be an analog of the brain cortex.

Causal Factors: 1. The simplest source of noises in the ear is probably an accumulation of *wax* in the external audi-

tory canal, and its drum-like impact on the tympanic membrane. *Foreign bodies* in the external canal act similarly and are not infrequent.

2. Otosclerosis seems to be the most constant intra-aural cause.

3. Middle ear infection is frequently, but not constantly, accompanied by tinnitus. Other infections in or about the ear have also been implicated.

4. Nasal anatomical abnormalities frequently condition head noises. The writer's Case 1 is an example.

5. Paresthesia states have been suggested as an analog of tinnitus. A clinical study of suitable instances of actual head noises from this viewpoint would be a valuable addition to the subject.

6. Acoustic Nerve Tumor: One interesting fact in this relation for the problems of tinnitus is that tinnitus is by no means always present. One report gives only 20 positives in 39 cases of tumor proved by operation.

7. Temporal Lobe Tumor: In this condition, also, noises are not always present. In a series of operated cases, only 11 of 59 experienced tinnitus. In another series of operations, there was only one positive for noise out of the total nine cases. What is the determining factor? Successful treatment of the condition would be aided by knowing.

8. Intracranial tumors not directly connected with the auditory path. In these cases, the increase in intracranial pressure doubtless is an important factor in causing tinnitus, but something more must be involved, since tinnitus is said not to have been reported in tumors below the midbrain.

9. Pharmacal: Among drugs causing abnormal hearing manifestations, quinine is the most familiar one; others reported are salicylates, ergot, aspirin, alcohol, mercury, caffeine, arsenic, morphine and others. This list represents agents of widely different physiological action on the human organism, and well indicates the complexity of the problem

being considered. Recent literature reports tinnitus after the use of streptomycin.

10. Circulatory: Hypertension is a frequent accompaniment of tinnitus, but since not all hypertensives, even among deaf persons, have head noises, it is apparently not the primary cause.

11. Metabolic disturbances. These may not be limited to such disease entities as diabetes, since head noises may occur in the deaf in the presence of such conditions as spastic colon, for example, when the ingestion of cellulose-containing foods cause an almost intolerable volume of noise. This reaction suggests a possible specific sensitivity, or allergy, and might prove a fruitful field for investigation.

12. Concussion or gunfire and other long-continued excessive noises have the effect of causing head noises. An example is given in the writer's Case 3, above.

This list is, of necessity, not exhaustive, but it includes the conditions most frequently seen by the clinical otolaryngologist. That the real significance of these factors is not fully known is shown by the fact that not all in any of these categories have head noises, and equally important for consideration is the additional one, that head noises are reported to occur in persons who are entirely free from any demonstrable disorder of the hearing apparatus or of the body as a whole.

Treatment: In view of the protean character of the subject considered, and the varying results of any one therapeutic agent, when given to a group with similar manifestations, the question of treatment is still on a trial and error basis. The most important point may be that the patient should be treated, rather than the complaint itself.

Among therapeutic agents in recent use, *1. prostigmine* has had support, but its effectiveness has not been universal, and its use has been entirely discarded by some experienced physicians.

2. Stellate Ganglion Block: As an example of this method,

in a report of its use in 18 cases, 12 were relieved temporarily only and two were made worse.

3. Vasodilators: One report gives these results; all were temporary:

a. Acetylcholine: generally good.

b. Sodium nitrite: of seven cases, five, temporary improvement; two, no change.

c. Prostigmine: seven cases, none improved.

d. Strontium chloride: nine cases; three, temporary improvement; six, no change.
In a large series of 175 patients, 26 had relief; 84, temporary relief; 65, no change.

4. Vitamins. Ascorbic Acid (vitamin C): The writer has had good results in some early cases from large doses. *Nicotinic Acid:* A series of 69 cases has been reported, in which permanent relief was had by 13; temporary relief by 42; none in 14.

5. Surgery: tympanosympathectomy. The observation is reported that in chronic infectious middle ear conditions, the branches of the tympanic plexus, which can be seen in the cochlear promontory at operation, are present normally in patients with tinnitus, while where there were no noises, this plexus was entirely lacking. When the plexus was excised in patients with tinnitus, there was complete cure only in all of those with chronic inactive adhesive middle ear deafness. In five patients with almost normal hearing, five were relieved, two not relieved. Of four cases with total deafness and complete degeneration of the cochlear nerve, three were cured; one not cured. Among three patients with mixed middle and inner ear deafness, tinnitus disappeared in one; unchanged in two.

Magnesium Sulphate: The use of this salt has often been prescribed for tinnitus, with some success. It acts to reduce intracranial pressure by dehydration. It also has an effect on the nervous system similar to morphine, but much weaker.

Its use would, like all other means, be effective only in suitably selected cases.

Dietary: In some patients with head noises, the writer has found a study of the diet to be important. An effective method is to prescribe a liquid diet for three or four days, when noises often lessen, or sometimes stop entirely. Simple foods should then be taken, eliminating any that are related to a recurrence of head noise.

Conclusion: Tinnitus aurium can be more adequately expressed as head noise, since it is frequently not ringing in character, and may present no demonstrable involvement of the ear itself.

Head noises are not a disease entity but occur in relation to a great variety of abnormal states; but not in all persons having these abnormalities.

Head noises accompany some pathological ear conditions, but since they are not constantly present the ear pathology cannot be the determining factor.

Head noises may be caused by such agents as drugs of widely differing physiological action, but these drugs do not cause such head noises in all persons.

Head noises occur in persons who are entirely free of any yet demonstrated ear involvement or bodily disease.

A more careful study of persons with head noises, rather than head noises themselves, might well lead to greater understanding of the subject, since pursuing the latter course has left much still to be learned.

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CORRECTION.

In the paper, "Penicillin Therapy in Chronic Suppurative Sinusitis. A Report of 22 Cases," published in THE LARYNGOSCOPE for July, 1947, by Dr. Harold Boyd, on page 464, the last line, the word "increase" should read "decrease." The sentence when corrected to read: Proetz[12] reports that weaker solutions of penicillin have no damaging effect on the cilia or epithelium, and in addition tend to decrease ciliary action.

HEARING AIDS ACCEPTED BY THE COUNCIL ON PHYSICAL MEDICINE OF THE AMERICAN MEDICAL ASSOCIATION

Aurex (Semi-Portable)	JAMA 109:585 (Aug. 21) 1937 (tube)
Aurex Model C-B and Model C-A	JAMA 120:535 (Oct. 17) 1942 (tube)
Mfr. Aurex Corp. 1117 N. Franklin St. Chicago, Ill.	
Beltone Mono-Pac	JAMA 130:637 (Mar. 9) 1946 (tube)
Beltone Harmony Mono-Pac	JAMA 133:543 (Feb. 22) 1947 (tube)
Mfr. Beltone Hearing Aid Co. 1450 W. 19th St. Chicago, Ill.	
Maico Type K	JAMA 129:32 (Sept. 1) 1945 (tube)
Maico Atomeer	JAMA 133:942 (Feb. 22) 1947 (tube)
Mfr. Maico Co., Inc. North Third St. Minneapolis, Minn.	
Mears Aurophone Model 98	JAMA 118:978 (Mar. 21) 1942 (tube)
Mfr. Mears Radio Hearing Device Corp. 1 W. 34th St. New York, N. Y.	
Otarion, Model A-1	JAMA 115:1101 (Sept. 28) 1940 (tube)
Otarion, Model A-2	JAMA 125:849 (July 22) 1944 (tube)
Otarion, Model A-3	JAMA 132:1071 (Dec. 28) 1946 (tube)
Otarion, Model A-4 Jr.	JAMA 132:925 (Dec. 14) 1946 (tube)
Mfr. Otarion Hearing Aids 448 N. Wells St. Chicago, Ill.	
Paravox Models VV2 and VV3	JAMA 128:879 (July 21) 1945 (tube)
Paravox Models VH and VL	JAMA 132:79 (Sept. 14) 1946 (tube)
Paravox Model XT	JAMA 134:365 (May 24) 1947 (tube)
Mfr. Paraphone Hearing Aid Co. 2056 E. 4th St. Cleveland, Ohio	
Radioear Masterpiece	JAMA 117:2169 (Dec. 20) 1941 (carbon)
Radioear 45-CM	JAMA 126:1151 (Dec. 30) 1944 (tube)
Radioear Model 45-M-magnetic air conduction receiver	JAMA 127:219 (Jan. 27) 1945 (tube)
Radioear Model 45-M-magnetic bone conduction receiver	JAMA 127:27 (Jan. 6) 1945 (tube)
Mfr. E. A. Myers & Sons 306 Beverly Rd., Mt. Lebanon Pittsburgh, Pa.	
Silver Micronic Hearing Aid	Report not yet published
Mfr. Micronic Corp. 101 Tremont St. Boston 8, Mass.	
Ravox (Semi-Portable)	JAMA 113:18 (Oct. 28) 1939 (tube)
Mfr. Zenith Radio Corp. 6001 W. Dickens Ave. Chicago, Ill.	